Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

SECA FAQs

q: What is a fuel cell?

a: A fuel cell is an electrochemical energy conversion device that uses a carbon and/or hydrogen fuel source and air to produce electrical power.

q: What fuels can fuel cells use?

a: Solid oxide fuel cells can use virtually any fuel: coal gas, hydrogen, bio-fuel, gasoline, diesel, JP8, or propane.

q: How do fuel cells improve the environment?

a: Fuel cells are virtually emissions free and quiet. Featuring significantly improved efficiency in comparison to conventional natural gas- or coal-combustion based power generation, greenhouse gas emissions are reduced.

SECA R&D: *Where Competition Meets Collaboration*

From New York to California, SECA's Core Technology Program is working on dozens of fuel cell projects, led by the brightest minds from leading universities, national laboratories and businesses across the country. These competitively selected projects work together to provide vital R&D and testing support to SECA Industry Teams.

In the same spirit of healthy competition, the Industry Teams leverage the collective ingenuity of the Core Technology Program to independently pursue innovations in fuel cell design that can be mass produced at lower costs. The Industry Teams are working to solve the challenges of fuel cell technology, each using different approaches and techniques. As a result, the SECA program is rich in innovation, allowing it to reach its goals that much faster.

SECA: *Toward a Better Future*

By providing America with a cleaner, more affordable way to generate energy, fuel cell technology can potentially help us secure a better future in three key areas:

Energy Security

There are three big energy questions today: How do we ensure secure, reliable, and affordable energy for the future? How do we introduce new technologies into the existing energy infrastructure? How do we reduce our dependence on foreign oil?

With SECA fuel cell technologies, cheap, abundant fossil fuels such as coal will be able to generate power more cleanly and affordably. Coal has been a reliable energy source for many years, and since it is domestically produced, it is independent of foreign markets and importation.

Reducing the Carbon Footprint

By some estimates, America has enough coal to fuel the country's energy demands for many years. But in order to maintain our coal usage, we need to reduce the amount of carbon dioxide being emitted into the atmosphere. SECA fuel cell technology can realize the clean-energy potential of coal with 99 percent carbon capture through gasification and carbon sequestration processes. Through the use of SECA fuel cells, clean coal technologies have the potential to dramatically improve the performance of today's power plants, and to develop a virtually pollution-free coal plant in time for the next wave of power plant construction.

Conserving Water

The Ogallala Aquifer, which supplies groundwater to the Great Plains, is at record lows. Lake Mead is drying up. The Great Lakes—the largest freshwater supply in the world—are receding. California had its driest spring on record. Over the next ten years, water is going to be a major issue in the United States and throughout the world. Experts predict that we are entering a new era of water scarcity, and there is a pressing need for industry to better manage its water usage. Nuclear and steam power plants in particular use vast amounts of water for cooling and steam production. SECA fuel cells are leading the world in revolutionary near-zero water energy sources. Through this innovative fuel cell technology, waterless power plants may become commonplace in the future, helping areas that most need to conserve water.

The Department of Energy projects that SECA technology will save the United States more than $100 billion by 2025 through increased efficiency leading to lower fuel costs and meeting emissions and carbon sequestration requirements without expensive control equipment.

SOLID STATE ENERGY CONVERSION ALLIANCE
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U.S. Department of Energy
National Energy Technology Laboratory • Pacific Northwest National Laboratory

Fuel Cells *Powering* AMERICA

Increase Energy Security
Reduce Carbon Footprint
Enhance Water Conservation

SOLID STATE ENERGY CONVERSION ALLIANCE

SECA: *Realizing a Vision of Clean Energy for America*

The Solid State Energy Conversion Alliance (SECA) program is working on a fuel cell paradigm that will have a dramatic impact on energy use in America. Managed by the Office of Fossil Energy's National Energy Technology Laboratory (NETL), the program's primary goal is to deploy fuel cells in near-zero emission coal plants, capturing 99 percent of the carbon, greatly reducing water requirements, and maintaining low energy costs. The realization of this goal will ultimately increase energy security, reduce the world's carbon footprint, create a new energy economy, and help conserve increasingly precious natural resources such as water.

The program has made substantial progress in producing fuel cells for virtually any stationary application using fossil fuels. SECA research and development teams have reached their latest set of technological milestones to put fuel cell power systems on the path to commercialization and more widespread use in the near future. The demonstration of SECA fuel cell technology in auxiliary power units (APUs) that produce power and reduce emissions for the trucking industry, and as potential power sources for Unmanned Underwater Vehicles, speak to the success of SECA fuel cell technology.

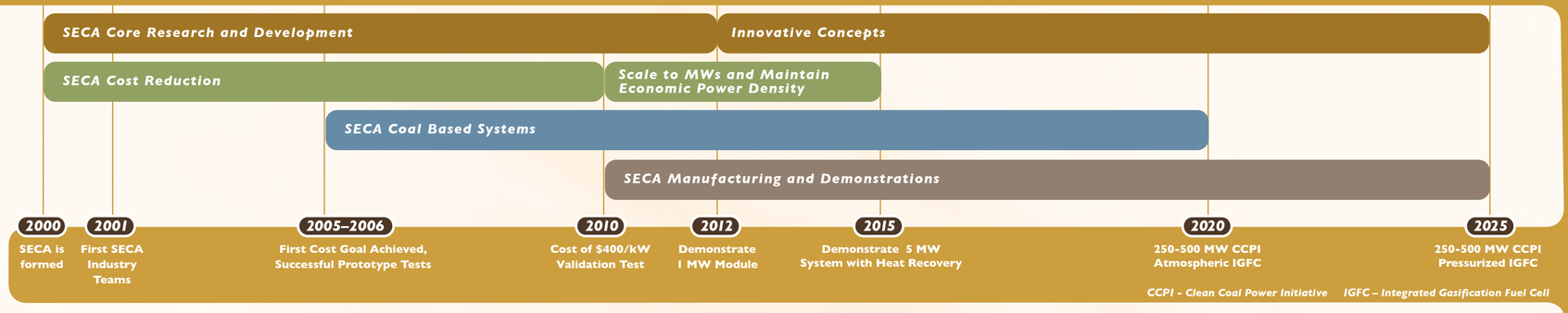
Delphi Diesel SECA-Based APU Peterbilt Demo

SECA Program Targets

- **2010** Demonstrate system cost of $400/kW and stack cost of $100/kW
- **2012** Demonstrate 1 MW building blocks for 5 MW demonstrations in 2015 and 250-500 MW CCPI projects in 2020/2025
- **2015** Demonstrate 5 MW systems integrated with heat recovery (e.g., turbine) and gasification producing methane (25%)/syngas fuel
- **2020** Demonstrate CCPI projects, atmospheric fuel cell technology, achieve over 50% efficiency with low cost carbon capture and near-zero water requirements
- **2025** Demonstrate CCPI projects, pressurized fuel cell technology, achieve 60% efficiency with low cost carbon capture and near-zero water requirements

CCPI - Clean Coal Power Initiative

Fuel cells convert the chemical energy of a fuel (coal gas, natural gas, diesel and bio-fuels) into electrical energy without combustion.



SECA Cost Reduction: *Leapfrogging Ahead*

Since it was launched in 2000, the SECA program has made remarkable progress in clearing one of its greatest hurdles—cost. Fuel cell technology has traditionally been too expensive for broad penetration into commercial markets. To be practical for widespread use in the marketplace, fuel cell systems need to be made viable through mass production, and they need to generate affordable power. The SECA program is making great strides in both areas and is well on the way to its 2010 goal of a tenfold reduction in costs to $400/kW, which is comparable to other stationary power systems. As SECA clears its hurdles, aggressive targets will continue to be met for further cost reduction, mass customization, and clean power performance.

Current progress also indicates that commercial-ready stacks, which are the power-producing components of a fuel cell system, will be ready in 2010. This will be followed by megawatt (MW) demos in 2012 and 5 MW demos in 2015. By 2017, the 1 MW and 5 MW demos will have demonstrated the lifetime and integration of fuel cell system and heat recovery (turbines) sufficiently to warrant sponsoring a Clean Coal Power Initiative (CCPI) project, resulting in a 250–500 MW Integrated Gasification Fuel Cell (IGFC) system in 2020 and 2025.

SECA Coal-Based Systems: *Clean Energy in a Carbon-Challenged World*

Why the focus on fuel cell technology and coal? Coal has great promise for a cleaner, more energy-independent future. A cheap and abundant fossil fuel, there are sufficient coal reserves in the U.S. alone to last the next few centuries. Coal powers half of our electricity, and by 2030, is expected to supply nearly 30 percent of the world's energy. It is also a domestic product, offering a substantial opportunity to secure our energy future and reduce our dependence on foreign oil. But coal leaves a big carbon footprint—and a big question. How do we reduce the carbon dioxide that is released into the atmosphere from using coal to produce power? That is where SECA fuel cell technology provides a solution.

SECA technologies now in development will make future coal-fired systems dramatically more efficient and cleaner while keeping electricity affordable. The Department of Energy's CCPI focuses on the development and demonstration of new clean coal technology. SECA technology presents a path to large new systems. The largest energy market and the largest impact on the Nation's energy needs are SECA fuel cells using coal as fuel. SECA coal systems can potentially operate at 60 percent efficiencies, providing low cost power with greater than 99 percent carbon capture and near-zero water usage. Because fuel cells can easily capture CO_2 emissions, they will have a huge impact on coal generation as a viable, near-zero emissions source of electricity.

The Federal Government Has Done It Before

Shippingport: *A Model for Success*

Historically, federal funding helps support game-changing technology that is too high-risk or costly for the public sector to do on its own. The SECA program takes its cue from a much earlier model of public/private partnership success. As part of President Eisenhower's "Atoms for Peace" program, the Shippingport Atomic Plant was the first government-funded nuclear energy program to partner with a private sector company and usher in a whole new concept in power generation. The Clean Coal Power Initiative provides the opportunity for SECA to follow the same public/private partnership path to establish a new nationally important way of producing electricity.

Shippingport Power Station Reactor Vessel, October 1956

Competitive Innovation: *Accelerating Technology Development*

The President's 2007 Budget cited the SECA program as leading the way in Government-industry partnerships.

"The SECA program leverages private-sector ingenuity by providing Government funding to Industry Teams developing fuel cells, as long as the Teams continue to exceed a series of stringent technical performance hurdles. This novel incentive structure has generated a high level of competition between the Teams and an impressive array of technical approaches. The SECA program also develops certain core technologies that can be used by all the Industry Teams to avoid duplication of effort. The program exceeded its 2005 performance targets, and it is on track to meet its goal for an economically competitive technology by 2010."

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SECA FAQs

q: Where are solid oxide fuel cells used?

a: Fuel cells can be used anywhere electric power is needed. Applications include providing power for homes and businesses from central- and distributed-power plants, as well as providing auxiliary power for buses, heavy duty trucks, military transports, RVs and more.

q: How efficient are fuel cells?

a: Fuel cells are much more efficient than today's conventional power generation technologies, because chemical energy is transformed directly to electrons.

q: How much do fuel cells cost?

a: The SECA fuel cell program will reduce the cost of fuel cells tenfold so that they can penetrate the power generation and transportation markets. SECA fuel cell technology will achieve its $400/kW target by 2010.